

WHAT IS CLAIMED IS:

1           1. A method comprising:

2           observing a finite duration signal  $y_n$  that comprises  
3 a representation of a mixture of a desired signal and an  
4 undesired signal, the undesired signal comprising an offset  
5 component;

6           modeling the offset component of the undesired  
7 signal as comprising a step function  $u$  defined by unknown step  
8 function parameters;

9           estimating the unknown step function parameters; and

10          adjusting  $y_n$  based on the estimated step function  
11 parameters.

1           2. The method of claim 1 in which  $y_n$  comprises a  
2 continuous signal.

1           3. The method of claim 1 in which  $y_n$  comprises a  
2 discrete signal.

1           4. The method of claim 3 in which:

2            $y_n$  includes  $N$  samples and comprises a discrete  
3 representation of a mixture of the desired signal, the  
4 undesired signal, and a second signal including a generally

5 sinusoidal waveform and an attenuated version of the desired  
6 signal; and  
7  $y_n$  is modeled as including a discrete representation  
8 of the desired signal and a discrete representation of an  
9 offset component related to a square of the undesired signal,  
10 in which the offset component is modeled as comprising a step  
11 function  $u$  defined by unknown step function parameters.

1 5. The method of claim 1 in which the step function  
2 parameters include a first parameter  $c_1$  indicative of a first  
3 amplitude of the step function, a second parameter  $c_2$   
4 indicative of a second amplitude of the step function, and a  
5 third parameter  $\alpha$  indicative of a point at which the step  
6 function transitions from the first amplitude to the second  
7 amplitude, and in which the desired signal is a function of at  
8 least one unknown signal parameter  $\theta$ .

1 6. The method of claim 5 in which  $y_n$  includes  $N$   
2 samples and estimating the step function parameters includes  
3 jointly estimating  $\theta$ ,  $c_1$ ,  $c_2$ , and  $\alpha$  ( $0 \leq \alpha < N$ ) based on a non-  
4 linear optimization method.

1 7. The method of claim 5 in which  $y_n$  includes  $N$   
2 samples and estimating the step function parameters includes

3 estimating  $c_1$ ,  $c_2$ , and  $\alpha$  ( $0 \leq \alpha < N$ ) based on a maximum  
 4 likelihood method.

1 8. The method of claim 7 in which the estimates of  
 2 the step function parameters comprise:

3 a first estimate  $\hat{c}_1$  of  $c_1$  where

$$4 \quad \hat{c}_1 \approx \frac{1}{\hat{\alpha}} \sum_{n=0}^{\hat{\alpha}-1} y_n ;$$

5 a second estimate  $\hat{c}_2$  of  $c_2$  where

$$6 \quad \hat{c}_2 \approx \frac{1}{N - \hat{\alpha}} \sum_{n=\hat{\alpha}}^{N-1} y_n ; \text{ and}$$

7 a third estimate  $\hat{\alpha}$  of  $\alpha$  where

$$8 \quad \hat{\alpha} \approx \arg \max_{\alpha_{Test}} \frac{1}{\alpha_{Test}} \left| \sum_{n=0}^{\alpha_{Test}-1} y_n \right|^2 + \frac{1}{N - \alpha_{Test}} \left| \sum_{n=\alpha_{Test}}^{N-1} y_n \right|^2, \quad 0 \leq \alpha_{Test} < N-1.$$

1 9. The method of claim 8 in which determining  $\hat{\alpha}$   
 2 comprises:

3 selecting more than one value of  $\alpha_{Test}$ ;

4 determining a value  $g$  for each selected value of

5  $\alpha_{Test}$  where

$$6 \quad g \approx \frac{1}{\alpha_{Test}} \left| \sum_{n=0}^{\alpha_{Test}-1} y_n \right|^2 + \frac{1}{N - \alpha_{Test}} \left| \sum_{n=\alpha_{Test}}^{N-1} y_n \right|^2 ;$$

7 selecting from among the determined values of  $g$  one  
 8 or more maximum values of  $g$ ; and

9 selecting  $\hat{\alpha}$  based on the one or more maximum values  
10 of g.

1 10. The method of claim 9 in which less than N  
2 values of  $\alpha_{\text{Test}}$  are selected.

1 11. The method of claim 7 in which estimating the  
2 step function parameters further comprises jointly estimating  
3  $\theta$ , c1, c2, and  $\alpha$  based on a non-linear minimization of a  
4 function comprising

$$\begin{aligned} f(\theta, c1, c2, \alpha) \approx & \sum_{n=0}^{\alpha-1} \left| y_n - \frac{1}{\alpha} \sum_{m=0}^{\alpha-1} y_m - \frac{A_0}{2} s_m(\theta) + \frac{1}{\alpha} \sum_{m=0}^{\alpha-1} \frac{A_0}{2} s_m(\theta) \right|^2 \\ & + \sum_{n=\alpha}^{N-1} \left| y_n - \frac{1}{N-\alpha} \sum_{m=\alpha}^{N-\alpha} y_m - \frac{A_0}{2} s_n(\theta) + \frac{1}{N-\alpha} \sum_{m=\alpha}^{N-\alpha} \frac{A_0}{2} s_m(\theta) \right|^2 \end{aligned}$$

6 in which the minimization is performed by computing  
7 one or more of the derivatives of f.

1 12. A system comprising:  
2 an observation circuit structured and arranged to  
3 observe a finite duration signal  $y_n$  that comprises a discrete  
4 representation of a mixture of a desired signal and an  
5 undesired signal, the undesired signal comprising an offset  
6 component;

7 a modeling circuit structured and arranged to model  
8 the offset component of the undesired signal as comprising a  
9 step function  $u$  defined by unknown step function parameters;  
10 an estimating circuit structured and arranged to  
11 determine estimated step function parameters representative of  
12 the unknown step function parameters; and  
13 a correction circuit structured and arranged to  
14 correct  $y_n$  based on the estimated step function parameters.

1 13. The system of claim 12 in which  $y_n$  comprises a  
2 continuous signal.

1 14. The system of claim 12 in which  $y_n$  comprises a  
2 discrete signal.

1 15. The system of claim 14 in which:  
2  $y_n$  includes  $N$  samples and comprises a discrete  
3 representation of a mixture of the desired signal, the  
4 undesired signal, and a second signal including a generally  
5 sinusoidal waveform and an attenuated version of the desired  
6 signal; and

7 the modeling circuit is further configured to model  
8  $y_n$  as comprising a discrete representation of the desired

9 signal and also a discrete representation of an offset  
10 component related to a square of the undesired signal.

1 16. The system of claim 12 in which the unknown  
2 step function parameters include a first parameter  $c_1$   
3 indicative of a first amplitude of the step function, a second  
4 parameter  $c_2$  indicative of a second amplitude of the step  
5 function, and a third parameter  $\alpha$  indicative of a point at  
6 which the step function transitions from the first amplitude  
7 to the second amplitude, and in which the desired signal is a  
8 function of at least one unknown signal parameter  $\theta$ .

1 17. The system of claim 16 in which  $y_n$  includes  $N$   
2 samples and the estimating circuit is further configured to  
3 estimate jointly the unknown step function parameters  $\theta$ ,  $c_1$ ,  
4  $c_2$ , and  $\alpha$  ( $0 \leq \alpha < N$ ) based on a non-linear optimization method.

1 18. The system of claim 16 in which  $y_n$  includes  $N$   
2 samples and the estimating circuit is further configured to  
3 estimate the unknown step function parameters  $c_1$ ,  $c_2$ , and  $\alpha$   
4 ( $0 \leq \alpha < N$ ) based on a maximum likelihood method.

19. The system of claim 18 in which the estimating circuit is further configured to estimate the unknown step function parameters as comprising:

a first estimate  $\hat{c}1$  of  $c1$  where

$$\hat{c}1 \approx \frac{1}{\hat{\alpha}} \sum_{n=0}^{\hat{\alpha}-1} y_n ;$$

a second estimate  $\hat{c}2$  of  $c2$  where

$$\hat{c}2 \approx \frac{1}{N - \hat{\alpha}} \sum_{n=\hat{\alpha}}^{N-1} y_n ; \text{ and}$$

a third estimate  $\hat{\alpha}$  of  $\alpha$  where

$$\hat{\alpha} \approx \arg \max_{\alpha_{Test}} \frac{1}{\alpha_{Test}} \left| \sum_{n=0}^{\alpha_{Test}-1} y_n \right|^2 + \frac{1}{N - \alpha_{Test}} \left| \sum_{n=\alpha_{Test}}^{N-1} y_n \right|^2 , \quad 0 \leq \alpha_{Test} < N .$$

20. The system of claim 19 in which the estimating circuit is further configured to determine  $\hat{\alpha}$  based on the following:

selecting more than one value of  $\alpha_{Test}$ ;

determining a value  $g$  for each selected value of

$\alpha_{Test}$  where

$$g \approx \frac{1}{\alpha_{Test}} \left| \sum_{n=0}^{\alpha_{Test}-1} y_n \right|^2 + \frac{1}{N - \alpha_{Test}} \left| \sum_{n=\alpha_{Test}}^{N-1} y_n \right|^2 ;$$

selecting from among the determined values of  $g$  one or more maximum values of  $g$ ; and

10 selecting  $\hat{\alpha}$  based on the one or more maximum values  
11 of g.

1 21. The system of claim 20 in which less than N  
2 values of  $\alpha_{\text{Test}}$  are selected by the estimating circuit.

1 22. The system of claim 18 in which the estimating  
2 circuit is further configured to estimate jointly the unknown  
3 step function parameters  $\theta$ ,  $c1$ ,  $c2$ , and  $\alpha$  based on non-linear  
4 minimization of a function comprising

$$f(\theta, c1, c2, \alpha) \approx \sum_{n=0}^{\alpha-1} \left| y_n - \frac{1}{\alpha} \sum_{m=0}^{\alpha-1} y_m - \frac{A_0}{2} s_m(\theta) + \frac{1}{\alpha} \sum_{m=0}^{\alpha-1} \frac{A_0}{2} s_m(\theta) \right|^2$$
$$+ \sum_{n=\alpha}^{N-1} \left| y_n - \frac{1}{N-\alpha} \sum_{m=\alpha}^{N-\alpha} y_m - \frac{A_0}{2} s_n(\theta) + \frac{1}{N-\alpha} \sum_{m=\alpha}^{N-\alpha} \frac{A_0}{2} s_m(\theta) \right|^2$$

5  
6 in which minimization is performed by computing one or more of  
7 the derivatives of  $f$ .

1 23. A computer program stored on a computer  
2 readable medium or a propagated signal, the computer program  
3 comprising:

4 an observation code segment configured to cause a  
5 computer to observe a finite duration signal  $y_n$  that comprises  
6 a representation of a mixture of a desired signal and an  
7 undesired signal, the undesired signal comprising an offset  
8 component;



9           a modeling code segment configured to cause the  
10 computer to model the offset component of the undesired signal  
11 as comprising a step function  $u$  defined by unknown step  
12 function parameters;  
13           an estimating code segment configured to cause the  
14 computer to determine estimated step function parameters  
15 representative of the unknown step function parameters; and  
16           a correcting code segment configured to cause the  
17 computer to correct  $y_n$  based on the estimated step function  
18 parameters.

1           24. The computer program of claim 23 in which  $y_n$   
2 comprises a continuous signal.

1           25. The computer program of claim 23 in which  $y_n$   
2 comprises a discrete signal.

1           26. The computer program of claim 25 in which:  
2            $y_n$  includes  $N$  samples and comprises a discrete  
3 representation of a mixture of the desired signal, the  
4 undesired signal, and a second signal including a generally  
5 sinusoidal waveform and an attenuated version of the desired  
6 signal;

7           a modeling code segment configured to cause the  
8 computer to model  $y_n$  as comprised of  $s_n$ , a discrete  
9 representation of the desired signal and also a discrete  
10 representation of an offset component related to a square of  
11 the undesired signal, in which the modeling code segment also  
12 is configured to cause the computer to model the offset  
13 component as comprising a step function  $u$  defined by unknown  
14 step function parameters.

1           27. The computer program of claim 23 in which the  
2 unknown step function parameters include a first parameter  $c_1$   
3 indicative of a first amplitude of the step function, a second  
4 parameter  $c_2$  indicative of a second amplitude of the step  
5 function, and a third parameter  $\alpha$  indicative of a point at  
6 which the step function transitions from the first amplitude  
7 to the second amplitude, and in which the desired signal is a  
8 function of at least one unknown signal parameter  $\theta$ .

1           28. The computer program of claim 27 in which  $y_n$   
2 includes  $N$  samples and the estimating code segment further  
3 comprises a non-linear optimization code segment configured to  
4 cause the computer program to estimate jointly the unknown  
5 step function parameters  $\theta$ ,  $c_1$ ,  $c_2$ , and  $\alpha$  ( $0 \leq \alpha < N$ ) based on a  
6 non-linear optimization method.

1           29. The computer program of claim 27 in which  $y_n$   
2 includes N samples and the estimating code segment further  
3 comprises a maximum likelihood code segment configured to  
4 cause the computer to estimate the unknown step function  
5 parameters  $c_1$ ,  $c_2$ , and  $\alpha$  ( $0 \leq \alpha < N$ ) based on a maximum  
6 likelihood method.

1           30. The computer program of claim 29 in which the  
2 maximum likelihood code segment is further configured to cause  
3 the computer to estimate the unknown step function parameters  
4 as comprising:

5           a first estimate  $\hat{c}_1$  of  $c_1$  where

$$6 \quad \hat{c}_1 \approx \frac{1}{\hat{\alpha}} \sum_{n=0}^{\hat{\alpha}-1} y_n ;$$

7           a second estimate  $\hat{c}_2$  of  $c_2$  where

$$8 \quad \hat{c}_2 \approx \frac{1}{N - \hat{\alpha}} \sum_{n=\hat{\alpha}}^{N-1} y_n ; \text{ and}$$

9           a third estimate  $\hat{\alpha}$  of  $\alpha$  where

$$10 \quad \hat{\alpha} \approx \arg \max_{\alpha_{Test}} \frac{1}{\alpha_{Test}} \left| \sum_{n=0}^{\alpha_{Test}-1} y_n \right|^2 + \frac{1}{N - \alpha_{Test}} \left| \sum_{n=\alpha_{Test}}^{N-1} y_n \right|^2, \quad 0 \leq \alpha_{Test} < N.$$

1           31. The computer program of claim 30 in which the  
2 maximum likelihood code segment further comprises:

3           a selecting code segment configured to cause the  
4 computer to select more than one value of  $\alpha_{\text{Test}}$ ;

5           a calculating code segment configured to cause the  
6 computer to determine a value  $g$  for each selected value of  
7  $\alpha_{\text{Test}}$  where

$$g \approx \frac{1}{\alpha_{\text{Test}}} \left| \sum_{n=0}^{\alpha_{\text{Test}}-1} y_n \right|^2 + \frac{1}{N - \alpha_{\text{Test}}} \left| \sum_{n=\alpha_{\text{Test}}}^{N-1} y_n \right|^2 ;$$

9           a  $g_{\text{max}}$  code segment configured to cause the  
10 computer to select from among the determined values of  $g$  one  
11 or more maximum values of  $g$ ; and

12           an  $\hat{\alpha}_{\text{max}}$  code segment configured to cause the  
13 computer to select  $\hat{\alpha}$  based on the one or more maximum values  
14 of  $g$ .

1           32. The computer program of claim 31 in which the  
2 selecting code segment is further configured to cause the  
3 computer to select less than  $N$  values of  $\alpha_{\text{Test}}$ .

1           33. The computer program of claim 29 in which the  
2 maximum likelihood code segment is further configured to cause  
3 the computer to estimate jointly the unknown step function

4 parameters  $\theta$ ,  $c1$ ,  $c2$ , and  $\alpha$  based on non-linear minimization  
5 of a function comprising

$$f(\theta, c1, c2, \alpha) \approx \sum_{n=0}^{\alpha-1} \left| y_n - \frac{1}{\alpha} \sum_{m=0}^{\alpha-1} y_m - \frac{A_0}{2} s_m(\theta) + \frac{1}{\alpha} \sum_{m=0}^{\alpha-1} \frac{A_0}{2} s_m(\theta) \right|^2$$
$$+ \sum_{n=\alpha}^{N-1} \left| y_n - \frac{1}{N-\alpha} \sum_{m=\alpha}^{N-\alpha} y_m - \frac{A_0}{2} s_n(\theta) + \frac{1}{N-\alpha} \sum_{m=\alpha}^{N-\alpha} \frac{A_0}{2} s_m(\theta) \right|^2$$

6  
7 in which the minimization is performed by computing one or  
8 more of the derivatives of  $f$ .

1 34. A processor which:

2 observes a finite duration signal  $y_n$  that comprises  
3 a representation of a mixture of a desired signal and an  
4 undesired signal, the undesired signal comprising an offset  
5 component;

6 models the offset component of the undesired signal  
7 as a step function  $u$  defined by unknown step function  
8 parameters;

9 determines estimated step function parameters; and  
10 corrects the signal  $y_n$  based on the estimated step  
11 function parameters.

1 35. The processor of claim 34 in which  $y_n$  comprises  
2 a continuous signal.

1           36. The processor of claim 34 in which  $y_n$  comprises  
2 a discrete signal.

1           37. The processor of claim 36 in which:  
2  $y_n$  includes  $N$  samples and comprises a discrete  
3 representation of a mixture of the desired signal, the  
4 undesired signal, and a second signal including a generally  
5 sinusoidal waveform and an attenuated version of the desired  
6 signal; and

7  $y_n$  is modeled as including a discrete representation  
8 of the desired signal and also a discrete representation of an  
9 offset component related to a square of the undesired signal,  
10 and models the offset component as a step function  $u$  defined  
11 by unknown step function parameters.

1           38. The processor of claim 34 in which  $y_n$  includes  
2  $N$  samples and the unknown step function parameters include a  
3 first parameter  $c1$  indicative of a first amplitude of the step  
4 function, a second parameter  $c2$  indicative of a second  
5 amplitude of the step function, and a third parameter  $\alpha$   
6 ( $0 \leq \alpha < N$ ) indicative of a point at which the step function  
7 transitions from the first amplitude to the second amplitude.

1            39. The processor of claim 38 in which the  
2 processor estimates the unknown step function parameters as  
3 comprising:

4            a first estimate  $\hat{c}1$  of  $c1$  where

5            
$$\hat{c}1 \approx \frac{1}{\hat{\alpha}} \sum_{n=0}^{\hat{\alpha}-1} y_n ;$$

6            a second estimate  $\hat{c}2$  of  $c2$  where

7            
$$\hat{c}2 \approx \frac{1}{N - \hat{\alpha}} \sum_{n=\hat{\alpha}}^{N-1} y_n ; \text{ and}$$

8            a third estimate  $\hat{\alpha}$  of  $\alpha$  where

9            
$$\hat{\alpha} \approx \arg \max_{\alpha_{Test}} \frac{1}{\alpha_{Test}} \left| \sum_{n=0}^{\alpha_{Test}-1} y_n \right|^2 + \frac{1}{N - \alpha_{Test}} \left| \sum_{n=\alpha_{Test}}^{N-1} y_n \right|^2 .$$